



Tennessee Consolidated Retirement System

# Level One Actuarial Audit

**Legacy Plan (Groups 021 and 024) and Hybrid Plan**

August 10, 2020

Brad Ramirez, FSA, FCA, MAAA, EA / Tammy Dixon, FSA, FCA, MAAA, EA

August 10, 2020

Jamie Wayman, Director  
Tennessee Consolidated Retirement System  
502 Deaderick Street  
Nashville, TN 37243-0201

**Re: Level One Actuarial Audit of the Tennessee Consolidated Retirement System**

Dear Mr. Wayman:

We are pleased to present the results of our full-scope (Level one) audit of the Tennessee Consolidated Retirement System (TCRS, or System). The purpose of this audit is to replicate the results presented in the Actuarial Valuation Report as of June 30, 2019 prepared by the System's actuary, Findley, and to determine whether the Plans are being funded on an adequate basis using actuarial assumptions that are reasonable, consistent and meet generally accepted actuarial principles, and, with respect to actuarial matters, whether the Plans are in compliance with State law and the policy of the Board of Trustees.

Segal reviewed the State and Higher Education Employees and K-12 Public School Teacher classifications in both the Legacy defined benefit (DB) plan and the Hybrid (DB/DC) plan. Other employee classifications were not reviewed. Our audit also includes a review of the Experience Study covering the period July 1, 2012 – June 30, 2016 prepared by Findley.

This review was conducted under the supervision of Brad Ramirez and Tammy Dixon. Both are Fellows of the Society of Actuaries, Fellows of the Conference of Consulting Actuaries, members of the American Academy of Actuaries, and Enrolled Actuaries under ERISA. This review was conducted in accordance with the standards of practice prescribed by the Actuarial Standards Board.

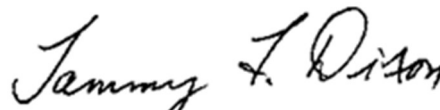
The assistance of the TCRS staff and Findley is gratefully acknowledged.

We appreciate the opportunity to serve as an independent actuarial advisor for the State of Tennessee and we are available to answer any questions you may have on this report.

Sincerely,

A handwritten signature in blue ink, appearing to read "BRAMIREZ", with a stylized flourish at the end.

Brad Ramirez, FSA, FCA, MAAA, EA  
Vice President and Consulting Actuary

A handwritten signature in blue ink, appearing to read "Tammy L. Dixon", with a stylized flourish at the end.

Tammy Dixon  
Vice President and Consulting Actuary

cc: Leon (Rocky) Joyner, Jr., FCA, ASA, MAAA, EA

# Table of Contents

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## Level One Actuarial Audit of the Tennessee Consolidated Retirement System

August 10, 2020

Executive Summary .....	2
Section I: Review of June 30, 2019 Actuarial Valuation Reports .....	6
Section II: Review of Actuarial Methods .....	20
Section III: Review of Test Lives .....	23
Section IV: Parallel Valuation Results.....	25
Section V: Conclusions .....	32

# Executive Summary

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The State of Tennessee Treasury Department retained Segal to conduct an independent Level one actuarial audit of the June 30, 2019 Actuarial Valuation Reports of the Tennessee Consolidated Retirement System (TCRS, or System) performed by Findley.

The objectives for this engagement included:

- A review of the quality of the Actuarial Valuation reports and Experience Study report;
- A review of the reasonableness and consistency of actuarial methods and assumptions, including the major economic assumptions (earnings, cost-of-living increases and salary);
- Replication of the valuation results to confirm reasonableness and accuracy of contribution rates and accrued liabilities;
- An evaluation of whether the valuation reflects state statutes and Board policies; and
- An evaluation of whether the valuation was performed in accordance with Actuarial Standards of Practice (ASOPs).

The primary objective of an actuarial audit of any valuation is to provide validation that the liabilities and costs of the System are reasonable and calculated as intended. This independent audit includes a full replication of the actuarial valuation results, plus a review of the key components in the valuation process that encompass the derivation of the liabilities and costs for TCRS.

These key components include the benefits valued, the actuarial assumptions and funding method used, and the asset valuation method employed. The valuation report and select valuation output for a number of active, terminated vested, and pay status test lives provided the detail necessary to validate each of these key components. We were not asked to evaluate the demographic data, any gain/loss analysis, or previous year valuations.

We reviewed all information supplied by TCRS, including sample benefit calculations for recent retirees. We also requested and reviewed additional information from Findley, including test lives and documentation of procedures beyond those disclosed in the valuation report.

## Summary of Findings

This peer review validates the findings of the June 30, 2019 actuarial valuations. Segal was able to match the valuation results and the test life output within an acceptable range. We concluded the valuations were performed in accordance with the Actuarial Standards of Practice (ASOPs) promulgated by the Actuarial Standards Board (ASB).

## Actuarial Valuation Reports

We began with a review of the Actuarial Valuation Reports for compliance with applicable standards of practice and governmental required reporting. Overall, it is our opinion that the reports completely and fairly present the results of the actuarial valuations and comply with all

applicable actuarial standards. We also offer ideas for improving the quality and understanding of the Actuarial Valuation Reports. The following is a summary of our key recommendations:

1. **We strongly suggest that Findley include an *Executive Summary or Valuation Highlights* section at the front of the valuation report that provides key results.**
2. **We suggest the 2019 Valuation section, currently located on page C-11, be provided before the ten-page history.**
3. The 2019 Valuation summary notes that the amortization schedule of each gain/loss tier was adjusted with the 2019 valuation. **We suggest the actuary show the number of years in the prior amortization schedules and the adjusted amortization schedules as well as the impact of the adjustment.**
4. **While the 2019 Actuarial Report prepared by Findley includes a basic Risk Discussion, we suggest the disclosure could be improved by providing financial projections.**
5. The Legacy Plan report shows a negative Unfunded Actuarial Accrued Liability (or surplus) for Teachers. **The report should indicate how this surplus is amortized in determining the contribution rates.**

## **Experience Study**

We also reviewed the Experience Study report for July 1, 2012 through June 30, 2016, the methodologies used to set the assumptions, and the recommendations that Findley provided. We considered the reasonableness of the proposed actuarial assumptions and methods in the context of our own experience, and those of other state and local pension systems. Details on our suggested modifications before the next experience study are in Section 1. We also offer ideas for improving the quality and understanding of the Experience Study report.

On February 29, 2016, the Pension Task Force (PTF) of the Actuarial Standards Board (ASB) released a report summarizing its opinions on various proposals to change pension standards related to public pension plans. The Experience Study was published on February 6, 2019 and we suggest Findley should have considered the PTF Report conclusions in preparing their reports.

## **Methods and Assumptions**

Overall, it is our opinion that the methodologies used to examine the System's assumptions and methods are reasonable and comply with the Actuarial Standards of Practice. The following is a summary of our key conclusions:

1. In our opinion, the Experience Study for July 1, 2012 through June 30, 2016 conforms to the appropriate Standards of Practice as promulgated by the Actuarial Standards Board.
2. The procedures used to analyze the assumptions are reasonable.
3. The recommended economic and demographic assumptions appear to be reasonable in light of the plan experience.
4. The actuarial cost method (individual entry age normal) also meets actuarial standards, and

is the most commonly used method among public sector plans.

5. In our opinion, the asset valuation method, with ten-year smoothing and a 20% corridor around market value, is reasonable and meets actuarial standards. However, we note that the majority of public plans use a shorter smoothing period.
6. The Pension Task Force of the Actuarial Standards Board (ASB) suggests disclosure of a solvency (market-consistent) value of liabilities in the actuarial valuation report. The Actuarial Standards Board has issued an Exposure Draft for ASOP No. 4 that would require this disclosure in valuation reports.

## Valuation Results

Our replication of the TCRS Legacy valuation produced results that are 0.7% higher than Findley for the total Actuarial Present Value of Projected Benefits, 0.7% lower for retirees and beneficiaries, 0.5% higher for inactive and vested deferred members and 2.4% higher for active members.

Our replication of the TCRS Hybrid valuation produced results that are 1.1% higher than Findley for the total Actuarial Present Value of Projected Benefits, 0.7% higher for inactive and vested deferred members, 1.2% higher for active members, and an exact match for retirees.

Differences less than 5% are generally considered a reasonable match. The results for both Plans are well within that tolerance. Additional detail on the replication of the valuations are in Sections III and IV.

With that said, Segal did find some areas where the valuation could be improved with regard to the accuracy of liability calculations. Our key recommendations are as follows:

1. Return of Excess Contributions – TCA 8-37-212 provides that the excess, if any, of accumulated contributions over the sum of actual retirement allowance payments received be paid as a lump sum to the surviving beneficiary or estate. Our analysis of the test lives indicates that this provision was not valued in the liability, although it is described on page G-2 of the Legacy valuation report. The effect of this coding difference was minimal. **We recommend that Findley program the return of contributions plan provision.**
2. For current terminated vested participants and for Legacy vested active participants assumed to withdraw from employment before eligibility for retirement and elect a deferred annuity, Findley programming assumes there is no liability for deaths prior to commencement of the deferred annuity. However, a death benefit would be payable in that situation (an annuity to married participants with 10 or more years of service or lump sum return of contributions in all other cases). The effect of this coding difference was minimal. **We recommend that Findley program these pre-retirement death benefit provisions.**
3. For retirements from active status, Findley currently assumes that no participants will elect reduced early retirement benefits. We think this is likely an oversimplification (although we have not analyzed any actual retirement experience). **We recommend use of early retirement decrements be considered and anticipate that implementing a reduced early retirement assumption could increase liabilities for the Legacy Plan.**

4. For retirements from terminated vested status, Findley currently assumes that participants will commence benefits at Service Retirement eligibility (except Legacy active participants terminating in a future year, who are assumed to retire at their earliest retirement age). A single retirement age for terminated vested participants is unlikely to adequately capture the range of retirement scenarios for such participants. **We recommend that consideration be given to retirement rates based on age/eligibility, similar to the assumption for retirements from active status.**
5. Findley notes in its summary of plan provisions that all pre-retirement deaths are assumed to be ordinary (i.e. not in the line of duty). We expect that, in most cases, the benefit for a line-of-duty death would be more valuable than the ordinary death benefit, so that implementing any probability of line-of-duty deaths would increase liabilities. However, the magnitude of the change would be dependent on the exact assumption chosen. **We recommend that an explicit assumption be applied to determine ordinary and line-of-duty deaths.**
6. For pre-retirement deaths that occur after reaching retirement eligibility, an annuity is payable to the beneficiary of all participants (not just married participants). Findley's current methodology assumes that only 80% of participants (those assumed to be married) receive the annuity, while the remaining 20% receive the lump sum death benefit. **We recommend valuing the greater of the two possible death benefits for 100% of deaths occurring after retirement eligibility.**
7. For pre-retirement deaths that occur before reaching retirement eligibility and where the participant is assumed to be married, Findley's coding for the Hybrid Plan does not appear to reflect any early retirement reductions that would apply. **We recommend applying the early retirement reductions, where applicable.**

These items and our recommendations are described in more detail throughout this report.

# Section I: Review of June 30, 2019 Actuarial Valuation Reports

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Findley generally provides a comprehensive actuarial valuation report which includes sufficient information for an individual to gain an understanding of the financial picture of the System. In reviewing the reports, we paid particular attention to the Actuarial Standards of Practice (ASOPs) No. 4, 41, and 51. Those ASOPs are briefly summarized below, followed by our comments on the reports.

## **ASOP No. 4**

Actuarial Standard of Practice (ASOP) No. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*, is the umbrella standard for actuaries performing pension plan valuations. It provides guidance to the actuary for measuring and disclosing pension plan obligations. Actuaries should assess the plan sponsor's funding policy and disclose rationale for the procedures used. In general, we find the Findley actuaries have met the standards of ASOP No. 4 and the procedures used to determine required contribution rates are reasonable.

Disclosures required by ASOP No. 4 include the intended purpose of the measurement, a summary of the plan provisions, data, and assumptions, a description of the normal cost method used, the amortization method, funded status using both an actuarial value and market value, and disclaimers about future measurements.

ASOP No. 4 directs actuaries to other actuarial standards for guidance on assumptions and methods. Our audit of the Findley Experience Study includes commentary on the guidance provided by ASOP No. 27 (Economic Assumptions) and No. 35 (Non-Economic Assumptions). We generally found Findley to have met these standards.

## **ASOP No. 41**

ASOP No. 41, *Actuarial Communications*, recognizes that complete disclosure of all supporting information is neither practical nor necessary. Section 3.2 of ASOP 41 states that the actuary should "identify the methods, procedures, assumptions, and data used by the actuary with sufficient clarity that another actuary qualified in the same practice area could make an objective appraisal of the reasonableness of the actuary's work as presented in the actuarial report."

In general, we found the Findley description of assumptions and methods to be clear and comprehensive. However, we believe Findley's January 24, 2020 "Supplement to the TCRS June 30, 2019 Actuarial Valuation" (Legacy Plan) may have overlooked some of the ASOP No. 41 requirements, specifically a summary of methods and assumptions and a statement of professional opinion. We also note that the Supplement was dated four months before the Actuarial Report dated May 18, 2020.

Other suggestions for improved communication in the actuarial report can be found in Section I.

## ASOP No. 51

ASOP No. 51, *Assessment and Disclosure of Risk*, is effective for valuations with measurement dates on or after November 1, 2018. Findley included some basic risk measures and generally met the requirements of this standard. **We recommend providing additional information about the risks of actual future measurements deviating from expected due to experience deviating from the assumptions. We also suggest that the risk measures presented include a discussion of how these measures evaluate risk and any trends that may be developing.**

### TCRS Legacy Plans Actuarial Valuation and Report

1. **We strongly suggest that Findley include an *Executive Summary* or *Valuation Highlights* section at the front of the valuation report that provides key results.** This might include items such as the current and prior year actuarially determined contribution rates, assets and liabilities, funded percentages, and any significant changes since the prior valuation (for example, investment or demographic gains or losses, assumption changes, plan changes, membership changes). It could also include consultative commentary.
2. Section C, Determination of Funding Levels, includes the System's detailed funding history from 1981 through 2018. **We suggest the 2019 Valuation section, currently located on page C-11, be provided before the ten-page history.** Perhaps the history could be included as an Appendix to the valuation report, so that the reader can readily reach the current valuation results.
3. The 2019 Valuation summary notes that the amortization schedule of each gain/loss tier was adjusted with the 2019 valuation. **We suggest the actuary show the number of years in the prior amortization schedules and the adjusted amortization schedules as well as the impact of the adjustment.** It would be useful for the user of the report to know whether the amortization periods for individual schedules were extended, shortened, or both.
4. The first paragraph under *Future Expectations* (page C-12) discusses the ten-year period for smoothing investment gains or losses, and also managing volatility by resetting the amortization period for the unfunded accrued liability. This is, in effect, a double-smoothing. **We suggest that Findley provide TCRS with projections of expected future contribution requirements that show effect of each smoothing technique by itself, and together, so that it is clear to the reader how much the combined approach is deferring overall experience gains or losses.**
5. The newest Actuarial Standard of Practice (ASOP) No. 51 addresses *Assessment and Disclosure of Risks Associated with Managing Pension Obligations*. **While the 2019 Actuarial Report prepared by Findley includes a basic Risk Discussion, we suggest the disclosure could be improved by providing financial projections.**

For example, the investment risk discussion notes that there is a risk that the funded status and required contributions could be "very volatile". The System would benefit by

having projections that quantify what “very volatile” means in terms of potential required changes in contributions. Similarly, it may be useful for the System to understand how contribution requirements may differ if the total payroll grows less quickly (or declines) compared to the payroll growth assumption.

ASOP No. 51 also requires that the actuary recommend a more detailed assessment of risks if he or she thinks believes it would provide the System with a better understanding of risks inherent in a plan. We note that Findley did not suggest any further analysis of risk for the System. A review of any additional risk analyses, if performed, is beyond the scope of our audit.

6. Page C-15 provides a chart showing the Value of Benefits. **We suggest commentary be included to help the System understand the numbers presented.**
7. Page C-16 provides a chart showing the History of Contribution Rates. Findley should clarify whether these are Total Rates or Employer Rates. **It could also be interesting to compare the contribution rate history to other key metrics such as the funded percentage history or growth in assets over the 30-year time period.**
8. Page C-18 provides a breakdown of liability by status. We note that the liability for “present active members” includes certain individuals in the data with an active status code, but P (“prior”) service status. Such participants are valued as though they are terminated, so they may be more accurately classified in the “former members” group. In either case, **the active and inactive group descriptions in the report could be improved to more easily distinguish where the liability is included.**
9. **We recommend the *Gain and Loss Analysis* include a demonstration of the total gain or loss in the Unfunded Accrued Liability since the prior valuation, and show what portion is related to investment experience.** The *Gain and Loss Analysis* does include a useful breakdown of the causes of change in contribution rates.
10. **We suggest that the increases from prior service purchases and sick leave credits could be addressed by setting an explicit assumption for these variables. We recommend that the actuary explicitly describe the re-amortization of unfunded liability.** (The contribution rates increased as result of this item, which indicates the amortization period was reduced.)

The “Other” category is a material source of change, particularly for the Teachers where it represents more than 20% of the total change prior to amortization period adjustments. **We recommend that when this “Other” source of change is large, that further investigation into the sources such as retirement and turnover experience be shown.**

11. Page E-2 shows a negative Unfunded Actuarial Accrued Liability (or surplus) for Teachers. **The report should indicate how the surplus is amortized in determining the contribution rates.**

This page is titled “Schedule of Funding Progress,” but includes only the current year information. The reader is directed to the TCRS Comprehensive Annual Financial Report for information on earlier periods. **Adding a graph with the historical funded ratios would be informative.**

12. The Appendix includes Tables I and II that show a distribution of active members by Age (Table I) and Service (Table II). **Generally, data is shown in a single combined Age and Service table, and that format may be more useful to the reader.**
13. Table VI-2 shows each amortization unfunded liability base and the number of years over which it is amortized in the current year valuation. **We recommend the number of years over which the bases were amortized in the prior year valuation also be shown.**
14. Table VIII summarizes actuarial assumptions and methods. Actuarial standards related to actuarial communications require that assumptions be sufficiently described for another actuary to be able to understand what was used in the calculations. Based on our review of test lives and related discussions with Findley, **the Post-Retirement Mortality table descriptions on page H-29 should be clarified to indicate that there are three separate mortality improvement scales used to convert the SOA RP-2014 table into the final valuation mortality table.** The base RP-2014 tables are projected back to 2006 using MP2014, forward to 2014 using MP2016 (this produces the base rates from the 2016 experience study), and then from 2014 to 2025 using MP2018. Findley could opt to refer to the RP-2014 table with MP2014 backed out as RP-2006, which has recently become accepted terminology.
15. We note that Findley does not assume that future disabled retirees will receive any worker's compensation benefits when determining the maximum disability benefit. **We recommend disclosing this assumption in the Summary of Actuarial Methods and Assumptions in the report.**
16. Our review of test lives indicates that the actual Pre-Retirement Mortality table in use for Legacy participants is the base 2006 rates from the RP2014 Employee Mortality Table (colloquially, the RP2006 Employee Mortality Table) with projection from 2006 to 2034 (15 years beyond valuation date) using the MP2014 projection scale. This differs from the description on page H-29 of the valuation report. We assume that this is the intended table, and **the pre-retirement mortality assumption in the report should be updated to reflect the table being used.**
17. For Legacy participants hired before July 1, 1997, Findley does not assume that any future disablements will occur in the line-of-duty. **We recommend disclosing this disability assumption in the Summary of Actuarial Methods and Assumptions in the report.**
18. Table IX states there were no changes in assumptions. However, there were updates to the administrative expense assumption and generational mortality improvement scales. **We recommend all assumption changes and their impact on liabilities be disclosed.**

### **Comments on the Legacy Plan Provision Summary**

The TCRS benefit provisions, summarized in Section G of the Legacy Plan's Actuarial Valuation Report, are generally consistent with the TCA Title 8, Chapters 34 – 39. Nonetheless, we observed some areas where the descriptions could be clarified. Note that in areas where the plan provisions differed by group, our review was limited to Group I. The Findley valuation report page numbers are included for clarity.

## Page G-1

1. The Average Final Compensation definition should specify that it is limited to average earnable compensation, and further define “earnable compensation” as specified in TCA 34-101(14) (i.e., bonuses are generally included, and also includes cash value of cafeteria benefits).
2. The Average Final Compensation definition should indicate that compensation in excess of IRC Section 401(a)(17) limits is disregarded.

## Page G-2

3. **The actuarial reductions for optional forms of payment should be described further by indicating the actuarial basis for such adjustments.**
4. The cost of living adjustment (COLA) section should indicate the exact CPI index used (All Items, US City Average) and describe the rounding conventions described in TCA 8-36-701 when the increase in index falls between 0% and 1%.
5. **The current interest rate used to accumulate the employee contribution account balance (5%) should be disclosed.**

## Page G-4

6. **The age 60 requirement for Service Retirement requires five years of service for members with Date of Hire after 1991. (TCA, Chapter 36, Part 2, paragraph 201(a)(1)). This should be noted in the report.**
7. The benefit percentages listed should clarify that the formula is a flat 1.75% for members who do not participate in Social Security.
8. **We suggest including a description of the Retirement Benefit for Teachers and General State employees who work beyond age 65, where the benefit is actuarially increased for delayed commencement (TCA 8-36-208(b)).**

## Page G-5

9. **The Vested Benefit amount should be clarified to indicate that the 15% reduction for each year of service less than 10 years is only applicable if the benefit commences before service retirement eligibility.**
10. The Minimum Benefit of \$96 per year of service is applicable for members with 10 years of service. If the member has less than ten years of service, the Minimum Benefit is \$84 per year of service (TCA 8-36-209). This is explained on page G-3, but can be easily missed. We suggest that adding this directly into the Minimum Benefit section would help avoid confusion.
11. The Ordinary Disability benefit amount may be more easily described as 9/10 of the Service Retirement benefit (including projection of service, as applicable). This would also be more consistent with the phrasing in TCA 8-36-501.

12. **The Maximum Disability Benefit should be clearly described as 75% of AFC when applied to the combined value of the Ordinary Disability benefit and any worker's compensation benefit (TCA 8-36-501(c)(7)).**
13. The Minimum Benefit of \$96 per year of service is applicable for members with 10 years of service. If the member has less than ten years of service, the Minimum Benefit is \$84 per year of service (TCA 8-36-209). This is explained on page G-3, but can be easily missed. We think that adding this directly into the Minimum Benefit section would help avoid confusion.
14. **The Accidental Disability benefit is also subject to the maximum of 75% of AFC, when considered in combination with any workers compensation benefit (TCA 8-36-502(c)(1)(C)).**
15. **It is worth clarifying that the age 55 Inactive Disability Benefit to which the actuarial adjustment is applied would also reflect early retirement adjustments of 4/10 of 1% per month prior to the service retirement date and 15% reductions for each year of service less than 10 years.**
16. **The Ordinary Death Benefit should be clarified to explain that the beneficiary need not be a spouse.** In addition, in the event that the beneficiary is a spouse and the spouse dies before all children reach age 19 (age 22 if full-time student), the benefit continues until all children reach age 19 (age 22 if full-time student), marry, or die (TCA 8-36-109(a)(3)).

17. **The eligibility for the Ordinary Death Benefit for those with at least 5 years of service, but not eligible for early or service retirement, could be further clarified to include only participants who are married at the time of death.**
18. The description should clarify that the duration of Accidental Death Benefit payments is dependent on the relationship of the beneficiary to the participant. For surviving spouses, the benefit is payable for life. For surviving children, the benefit is payable until all children reach age 19 (age 22 if full-time student), marry, or die.
19. The assumption that all death benefits are Ordinary Death benefits for valuation purposes would be more appropriate to include in the summary of actuarial assumptions.
20. **The Inactive Death Benefit eligibility description could be further clarified to include only participants who are married at the time of death.**
21. The description should be clarified that the Inactive Death Benefit amount is reduced by 4/10 of 1% for each month the death preceded the Service Retirement date (TCA 8-36-123).
22. **The Inactive Death Benefit section would be more complete by including the lump sum return of the member's account balance in situations where the participant is unmarried at the time of death or has less than 10 years of service.**

## TCRS Hybrid Pension Plans Actuarial Valuation and Report

1. **We suggest that the Summary include other key valuation results in addition to the actuarially determined contribution rates.** This might include items such as the current and prior year actuarially determined contribution rates, assets and liabilities, funded percentages, and any significant changes since the prior valuation (for example, investment or demographic gains or losses, assumption changes, plan changes, membership changes). It could also include consultative commentary.
2. **While the 2019 Actuarial Report prepared by Findley includes a basic Risk Discussion, we suggest the disclosure could be improved by providing financial projections.** For example, the investment risk discussion observes the historical returns highlight substantial volatility from year to year. The System would benefit by having projections that quantify what this means in terms of potential required changes in contributions. Similarly, it may be useful for the System to understand how contribution requirements may differ if the total payroll grows less quickly (or declines) compared to the payroll growth assumption.
3. **We suggest including rationale for the 3.625% addition to the actuarially determined Hybrid Plan contribution rate (presumably this is a timing adjustment).**
4. The assumed rates of retirement for the Hybrid Plan are identical to those used for the Legacy Plan. While there is no credible experience for the Hybrid Plan as of yet, it is unusual that a new plan design would not have any anticipated effect on participant behaviors, such as retirement decisions. We recommend that retirement experience be monitored for the Hybrid and Legacy plans in case different retirement assumptions are warranted.
5. Page 26 states there were no changes in assumptions. However, there were updates to the administrative expense assumption and generational mortality improvement scales. **We recommend that the effect of these assumption changes be disclosed.**

## Comments on the Hybrid Plan Provisions Summary

The description of the defined benefit component provisions of the Hybrid Plan in the Findley reports are generally consistent with the TCA Title 8, Chapters 34-39. Nonetheless, we observed some areas where the descriptions could be clarified. The Findley valuation report page numbers are included for clarity.

### Page 16

1. “Credited Service” used throughout section is more accurately labeled “Creditable Service”. The definition of Creditable Service should include mention of military service, similar to Legacy Plan description.
2. “Average Earnings” used throughout section is more accurately labeled “Average Final Compensation”. The Average Final Compensation definition should specify that it is limited to average “Earnable Compensation”, and further define “Earnable Compensation” as specified in TCA 34-101(14) (i.e. bonuses generally included, and includes cash value of cafeteria benefits).

3. The Average Final Compensation definition should indicate that compensation in excess of IRC 401(a)(17) limits is disregarded.
4. In the Accrued Benefit definition, the \$80,000 maximum is indexed annually from July 1, 2012, not July 1, 2014 (TCA 8-35-256(h)). Although “Accrued Benefit” does not appear to be used anywhere in the actual code, we do agree that defining it here makes the summary easier to understand and organize.
5. The Accrued Benefit definition should also indicate the index with which the \$80,000 maximum is increased (CPI All Items, US City Average).

#### Page 17

6. **The Early Retirement Benefit actuarial reduction should indicate the actuarial basis used, and perhaps include sample factors for each integer retirement age from 60 through 64 (for Teachers and General State employees).**
7. The Disability Benefit description is far less detailed than in the Legacy valuation report. We recommend including the eligibility requirements, the projection of service to the Service Retirement Date, and the maximum of 75% of AFC when considered in combination with any worker’s compensation benefit.
8. The Death Benefit descriptions are far less detailed than in the Legacy valuation report. We recommend including the eligibility requirements and the amounts payable for the Lump Sum benefit or the Line-of-Duty benefit. There should also be a description of the actuarial reductions applicable to both 100% Joint and Survivor death benefits in the event the death occurs prior to the Service Retirement Date.
9. **For the Refund of Contributions benefit, the current interest rate used to accumulate the employee contribution account balance (5%) should be disclosed.**
10. The optional forms of payment should be disclosed, as well as the actuarial basis used to calculate the actuarial reductions.

#### Page 18

11. **The Cost of Living Adjustment section should indicate the exact CPI index used (All Items, US City Average) and describe the rounding conventions described in TCA 8-36-701 when the increase in index falls between 0% and 1%.**

### Comments on the Experience Study Report

Overall, the methodology that Findley used to review experience and set proposed assumptions meets professional actuarial standards of practice. Our findings with respect to specific sections of Findley’s Experience Study report are summarized as follows.

## Summary of Report

1. Tennessee Code Annotated, Section 8-34-503(b) requires an experience study at least once in each six-year period. The Government Finance Officers Association (GFOA) recommends that these studies be performed no less frequently than once every five years. The System has been commissioning experience studies every four (4) years which is more frequent than recommended by the GFOA and more frequent than required since the Code was amended in 1992. Most comparable retirement systems perform five-year studies. **Since the TCRS frequency exceeds the standard, we recommend the Board of Trustees consider whether the additional expense of performing studies over a four-year period is justified.**
2. The Introduction on page 1 begins with a discussion of the experience from 1976. Throughout the report, there is a substantial amount of history from 1976 forward. While this may be interesting, it is not necessarily relevant for any current assumption recommendations. **We suggest deleting this discussion of historical experience study results or moving to an Appendix. We recommend that more detail be added that is specific to the four-year period being studied.**
3. **Discussion of data collection refinements over time could also be moved to an Appendix.** We note that although the Introduction makes note of a more elaborate analysis of information that was not previously available, there is no detail provided as to what information was newly available or how it added to the experience analysis.
4. The primary reason for completion of actuarial experience studies is to ensure that the package of actuarial assumptions closely captures the experience of the Plan, which minimizes gains and losses from year to year, and by extension minimizes significant fluctuations in the actuarially determined contributions. **Segal recommends that a summary of the investment and non-investment gains and losses during the four-year period be included in the experience review, so that TCRS can see how closely the assumptions are tracking to experience.** There will always be gains and losses from year to year, as the assumptions are never going to be perfect. However, trends of consistent gains or consistent losses over several years can be telling when the actuary is recommending changes for the future.
5. We noted that relatively few assumption changes were made. There were no changes recommended for retirement rates, turnover rates, disability rates, or disability mortality. **While there is mention of the fact that each of the last two four-year study periods were unusual due to the Great Recession and subsequent recovery, impacting behavior patterns of State employees, more detailed analysis would have been useful.**
6. **We recommend that the report summary include the impact of changing to the recommended assumptions, with the effect of economic and demographic changes shown separately.** GRS made a similar recommendation in their 2010 audit of the System. The impact of changes will allow the TCRS Board to make better informed decisions on the recommended changes.

7. **We recommend that the actuary disclose total TCRS experience for each member classification. The total experience should then be separated into investment and liability experience gains and losses.**
8. **We recommend that trends be summarized at a high level. This is helpful to the reader in understanding the magnitude of deviations between actual and assumed experience, and trends that may have emerged over the four years can be recognized.**

## Demographic Assumptions

1. Actuarial Standard of Practice No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations* (ASOP No. 35) provides guidance for setting noneconomic assumptions used in actuarial valuations. The demographic assumptions used to value the System reflect the expected occurrence of various events among participants. The assumptions should reflect specific characteristics of the System and produce reasonable results. A reasonable assumption is one that is expected to model the contingency being measured and not expected to produce significant gains and losses.

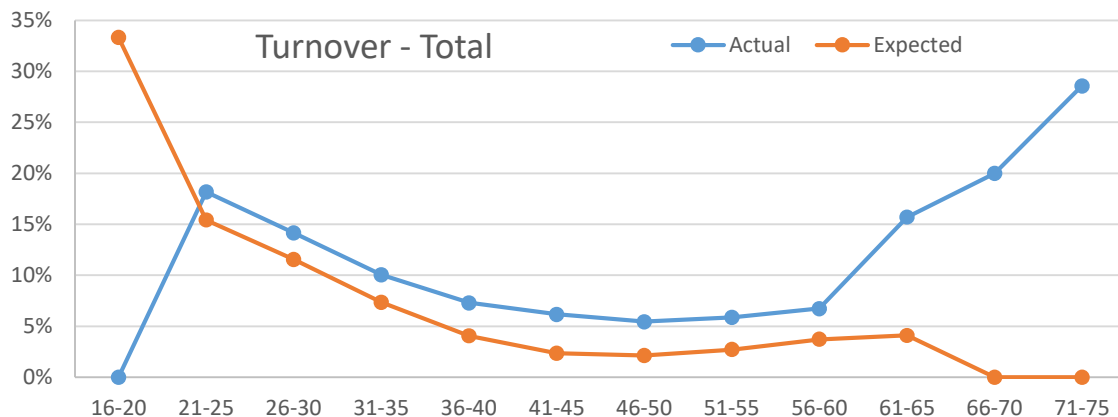
Overall, the methodology that Findley used to review experience and set proposed assumptions is appropriate and satisfies the relevant standards of practice.

2. **While we recognize stable contributions to be a desirable goal, the American Academy of Actuaries Pension Task Force also recommends consideration of benefit security and generational equity. One method of evaluating these competing objectives would be to introduce risk analyses that consider the impact on each objective when actual experience differs from projected.**
3. **In general, we suggest that the summaries of Actual and Expected experience be shown in graphical form, rather than just data tables.** For example, page 5 shows General State Ultimate Withdrawal experience for males and females, and for all members.

The total section shows:

Age	Exposure	Actual	Expected	Act/Exp
16-20	3	0	1	0.00
21-25	1,492	271	230	117.62
26-30	8,828	1,249	1,019	122.55
31-35	15,944	1,601	1,169	136.90
36-40	19,482	1,420	789	179.88
41-45	23,633	1,456	554	262.92
46-50	25,999	1,414	553	255.88
51-55	26,717	1,566	724	216.23
56-60	10,408	701	386	181.58
61-65	293	46	12	377.32
66-70	75	15	0	n/a
71-75	14	4	0	n/a
<b>TOTAL</b>	<b>132,888</b>	<b>9,743</b>	<b>5,438</b>	<b>179.17</b>

In our experience, showing the same data in another format can make it easier for readers to understand the experience and appropriateness of any new assumptions that are recommended. In this situation, a graph of the tabular information shows:



While 5-year age groupings may be appropriate in some situations, a review by individual age will generally be helpful. This is especially important for retirement rates, as there are often noticeable patterns of retirement upon reaching certain ages (such as Social Security or Medicare eligibility).

4. There does not appear to be an assumption for sick leave at retirement, even though sick leave is counted in credited service at the time benefits are calculated. Without an assumption, there are likely losses occurring annually when new retirees have more service than anticipated. **We recommend that Findley consider adding an assumption for sick leave in the future.** Depending on the average level of sick leave accumulated at retirement, we estimate introduction of a sick leave assumption could increase the actuarial liabilities for active participants by approximately 1% - 2%.
5. **We recommend showing the assumed decrement rates as well as counts of exposure and expected counts.** This would be helpful in identifying where rates are the same for different groups. For example, on page 5, it is not obvious whether the Withdrawal assumption is the same or different for Male and Female employees.
6. On page 6 of the report, Findley discusses the weighting of exposures and decrements by the liability amounts. **We suggest that the charts in the report include both unweighted and weighted results, so that the reader can determine the actual number of exposed lives and the number of assumed and actual deaths, retirements, etc. Titles and headings should clearly indicate when the numbers shown are weighted, or a footnote should be added to reflect this fact.**
7. In January 2019, the Society of Actuaries (SOA) released mortality tables based on the experience of public sector plan participants for the first time. **We recommend consideration of the SOA public sector tables, adjusted to reflect the System's experience, at the time of the next experience review.**
8. We note that the mortality experience for male teachers is eleven percent higher than the standard RP-2014 White Collar Table. The SOA tables recently published show both

male and female teachers have the lowest mortality rates (and the longest life expectancies), even compared to white-collar workers. **Given the unusual experience, the actuary may want to further investigate the TCRS' atypical mortality experience of male teachers.**

9. Even though the number of lives included in the mortality study is not fully credible, the System's experience has showed consistent mortality improvement. **The actuary may want to evaluate the impact of using full generational mortality improvement, rather than limiting mortality improvement to six (6) years for the Legacy Plan.** GRS made a similar recommendation in their 2010 audit of the System. We also note that Findley recommended generational mortality improvement for the Hybrid Plan, and we agree with this recommendation.
10. The discussion of pre-retirement mortality includes a statement that "deaths appear to be understated". We believe it would be helpful to include how the actuary confirmed the finding.
11. Findley opted to keep the disability mortality assumption, which is a table based on pre-1995 experience. Although there might not be enough deaths to be fully credible, the ratio of actual to expected deaths in this category was quite high. **Segal likely would have recommended a disability mortality table from the same family of RP-2006/RP-2014 tables that were chosen for non-disabled lives.** We estimate that the impact on the total actuarial accrued liability from a newer disability mortality table would not be material (approximately a 0.1% increase).
13. **We also recommend implementing an assumption for the proportion of pre-retirement deaths that are ordinary versus line-of-duty.** We anticipate that implementing any probability of line-of-duty deaths would increase liabilities. However, the magnitude of the change would be dependent on the exact assumption chosen.
14. The actuary noted that disability rates were inconsistent among all groups. Given the relatively small number of disability retirements, we would not necessarily characterize the results as inconsistent, particularly for male employees. The male disability Actual to Expected ratios range from 51.87% for Political Subdivisions to 54.82% for General State employees; the female disability rates range from 41.39% for Political Subdivisions to 62.07% for General State employees and 69.06% for Teachers.

**We suggest the Experience Study report disclose whether the disability rates are based on TCRS experience, or a standard table such as the Social Security Disability Rates, or some combination thereof.**

15. **The turnover discussion states that "ultimate rates are more important than the 'first-year' or 'second-year' tables". Although the ultimate rates are very important, the magnitude of the assumed turnover rates in the first two years of employment is relatively high.** For example, for General State male employees, the assumed turnover rate for an employee hired at age 30 is 23% in the first year and 18.6% in the second year of their careers, compared to a rate of only 9.6% in subsequent years. Turnover rates are critical in the development of normal cost under the entry age actuarial cost method.

However, we acknowledge the impact of the economic factors during much of the 2012-2016 study period and agree that the current assumptions are reasonable.

16. Findley currently assumes that no participants will elect reduced early retirement benefits. We think this is likely an oversimplification. **We recommend implementing an early retirement assumption**, and note this was also recommended by GRS in their 2010 independent audit of the System.
17. **We suggest the actuary clarify if the retirement experience summarized was for employees only, or both employees and vested inactive participants, and recommend participant groups be studied both separately and together.**
18. **The actuarial valuation uses assumptions for the percentage of participants who are married and the age difference between participants and spouses. These assumptions are not discussed in the experience study, and we recommend that they be reviewed as part of the next review.**

## **Economic Assumptions**

1. Actuarial Standard of Practice (ASOP) No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*, provides guidance in developing economic assumptions used in actuarial valuations. This ASOP was adopted in September 2013 and is applicable for actuarial valuations with measurement dates on or after September 30, 2014.

A key feature of ASOP 27 is the "building block" approach to setting assumptions. The "building block" approach uses the actuary's best estimate for the key components of economic assumptions: inflation, the risk-free rate of return, and the expected return premium (or risk premium) for each asset class. Generally, the actuary begins with a reasonable range for each component, and then selects a specific point within the range based on historical data, System specific data and the expectation concerning the future economic environment. Findley did not specify if they used the building block approach, but a specific illustration of the methodology used would be helpful.

2. The TCRS actuary used the 2017 Social Security (OASDI) Annual Report to review the System's inflation assumption. The 2.50% assumption is consistent with the average annual intermediate inflation rate of 2.6% used by the Social Security Administration Office of the Chief Actuary. The NASRA Issue Brief reports the average inflation assumption to be 2.8%. We believe the recommendation to decrease the rate of future inflation from 3.0% to 2.5% is reasonable.
3. The Experience Study reports states that "TCRS investments emphasize bonds and other fixed income securities..." but the TCRS Investment Policy target is only 20% domestic bonds and the target is 0% for inflation indexed bonds and international bonds. The total equity target for domestic stocks, international stocks and emerging market stocks is 49%.
4. The trend among public retirement systems is to lower the investment return assumption, particularly given the outlook for a low inflation environment. The NASRA

February 2020 Issue Brief reports that more than 70% of plans reduced their assumed rate of return since 2017. The average return assumption (weighted by plan size) for public sector retirement systems in the 2020 PPD data was 7.22%. The median investment return assumption reported in the NASRA February 2020 Issue Brief is 7.25%. The net investment return assumptions range from 6.5% to 8.0%, with an average 7.22% average return. The 7.25% assumption used for the June 30, 2019 valuations is in line with national benchmarks.

5. The TCRS actuary used the long-term average expected real returns from the 2017 Horizon Survey of Capital Market Assumptions in recommending a decrease in the System's return assumption from 7.50% to 7.25%. **We suggest the analysis could also include benchmarks from the NASRA Public Fund Survey or other similar surveys.**
6. The actuary tested the 7.25% assumption using long-term average returns, standard deviations, and correlations by asset class from the 2017 Horizon report, which showed a 50th percentile return of 7.24%. The 50th percentile is a critical value because there is a 50% probability that the actual annualized return exceed 7.24% and a 50% probability that the actual annualized return falls below 7.24%. **Investment risk can be evaluated by projecting key funding metrics as the rate of return varies. For example, the funded percentage or required employer contributions by using a 5.92% rate of return (the 25th percentile) or a 8.71% rate of return (the 75th percentile). We suggest this is a helpful alternative approach to viewing the range of results that may occur.**
7. The salary experience for TCRS was reviewed separately for Teachers and General employees but a single set of salary increases are used for both groups. **We recommend separate salary increases for Teachers and General employees be considered based on the actual experience.**
8. Economic assumptions have a significant effect on the development of System liabilities. Changes to these assumptions can substantially alter the results determined by the actuary. The goal is to have a consistent set of economic assumptions that appropriately reflect expected future economic trends, including inflation, investment returns and salary scale. Findley recommended a 0.5% reduction in future inflation with a 0.25% reduction in the rate of return and salary scale assumptions. **We suggest a discussion of the various components of the rate of return and salary scale be included in the next experience study to explain the rationale for this inconsistencies.**

## **Other Groups**

**We suggest the discussion of Group II and Group III classifications include a summary of the participants included in those groups (as is done in the Summary of the report).**

## Section II: Review of Actuarial Methods

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### Actuarial Methods

In October of 2014, the Conference of Consulting Actuaries Public Plans Community (CCA PPC) prepared a White Paper on Public Pension Funding Policy that supports a level cost allocation method as the basis for public plan funding policies. More recently, the Pension Task Force commissioned by the Actuarial Standards Board also made suggestions for public plan standards of practice. In particular, the PTF suggested that a reasonable actuarially determined contribution meets the following requirements:

ASOP Nos. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*, 27 and 35 are met

Each member's normal cost should be based on the benefit structure applicable to that member

The amortization payments should be greater than the nominal interest on the unfunded liability or pay off the unfunded liability in a reasonable period of time.

Fundamentally, the contribution requirement has two components:

Normal cost – the allocation to the coming year of pension costs for active employees in that year.

Amortization of the unfunded actuarial accrued liability (UAAL) – the coming year's payment toward pension costs allocated to prior years for which assets are not yet on hand.

The methods used for TCRS are in line with the CCA PPC White Paper and PTF suggestions.

### Actuarial Cost Method

The funding method employed is the traditional entry age normal (EAN) actuarial cost method and is the method used by the majority of the retirement systems in the Public Funds Survey. The traditional entry age normal (EAN) actuarial cost method determines the normal cost for an individual by calculating the level percent of pay that, if contributed each year over that person's career, would accumulate with interest to the amount projected to be needed to pay that person's pension benefits.

We find the current method to be reasonable. In addition, it is the same cost method required to determine liabilities under GASB accounting standards and therefore provides consistency among the various liability measures used in the valuation. We concur with the recommendation to maintain the method.

### Asset Valuation Method

An essential part of the public sector budgeting process is that material budget items, including pension contributions, should have a level cost pattern from year to year to the extent possible. An asset valuation method should establish a reasonable methodology for recognizing investment gains and losses and should limit the potential volatility that may result in increased contributions due to investment results.

The actuary's guide for determining the reasonableness of an asset smoothing method is ASOP No. 44, *Selection and Use of Asset Valuation Methods for Pension Valuations*. Two key principles arise from ASOP No. 44. First, an acceptable asset smoothing approach must create asset values that fall within a reasonable range around market value, and second, that gains and losses are recognized in a reasonable period of time. In lieu of satisfying both of these principles, a smoothing method could satisfy the requirements if, in the actuary's professional judgment, the range around market value is sufficiently narrow or the differences are recognized in a sufficiently short period.

Both the Legacy Plan and Hybrid Plan use an actuarial value of assets that recognizes a portion of the difference between the market value of assets and the expected market value of assets, based on the assumed valuation rate of return. The amount recognized each year is 10% of the difference. The actuarial value of assets is limited to a 20% corridor around market value, and the method treats gains and losses the same. This method has no systematic bias that would consistently produce an actuarial value of assets that is greater than or less than market value. In addition, the ten-year smoothing period is a reasonable time over which to recognize the market results. We agree the method is reasonable, but note that most public plans smooth the assets over fewer than ten years.

## **Amortization Methods**

The TCRS Legacy and Hybrid Plans both use a layered amortization method, with each new base amortized over a closed period not to exceed 20 years. Amortization payments are calculated as a level dollar amounts.

This approach will amortize the existing unfunded liability over a scheduled period. This method also has the result that every dollar of the current unfunded liability will be retired by a specified date, assuming the valuation and payroll growth assumptions are accurate.

Findley current creates one new amortization layer with each annual valuation. We recommend the actuary establish separate bases for experience gains or losses, assumption changes and plan changes rather than a combined base. The total amortization payment will be the same but the disclosure of sources of changes in liability is valuable information for the Board's plan management.

## **Comments on the Funding Policy**

The funding policy description for the Legacy Plan on page C-1 (5th paragraph) outlines the methodology used to calculate the Actuarially Determined Contribution requirement. We recommend the description be expanded to disclose that the state (TCA 8- 37-4) requires that the ADC be contributed each year.

The Hybrid Plan's funding policy is described on page 2 of the Hybrid Plan valuation report under the Analysis of Cost Controls and Unfunded Liability Controls. The employer's contribution is 4% of payroll, regardless of the ADC calculated in the annual actuarial valuation. If the ADC is less than 4% of payroll, the excess is contributed to a stabilization reserve account. If the ADC exceeds 4% of payroll, the shortfall will be covered by funds from the stabilization reserve, a reduction or suspension of the retiree COLA, movement of DC plan contributions, an additional 1% employee contribution, and reduction or suspension of future

service accruals. We recommend including a table that summarizes the ADC, employer contribution, and the reserve account contribution or shortfall for each plan or fiscal year.

## Section III: Review of Test Lives

### Test Life Output

We requested specific test lives in order to compare the benefit amounts projected in the valuation against our understanding of the TCRS benefits summarized in the valuation report and to assist in the matching of the overall results. A review of test lives generally permits the auditing actuary to understand the retained actuary's valuation programming on a benefit-by-benefit basis.

We were provided with results for 13 test lives, including six active members, two terminated vested members, and five retirees and beneficiaries. The key characteristics of these test lives, as well as a comparison of the Actuarial Present Value of Projected Benefits between Findley and Segal are outlined below. We were ultimately able to replicate all test life results within a reasonable tolerance, as shown in the charts below.

#### Active Test Lives

Plan	Description	Findley PVB	Segal PVB	Percent Difference
<b>Legacy</b>	• State employee, later entrant	\$647,735	\$644,525	-0.5%
	• State employee, earlier entrant	326,022	324,187	-0.6%
	• Teacher, later entrant	182,862	181,947	-0.5%
	• Teacher, earlier entrant	313,399	313,337	0.0%
<b>Hybrid</b>	• State employee, later entrant	18,600	18,453	-0.8%
	• State employee, earlier entrant	55,536	55,586	0.1%
<b>Total Active Test Life Suite:</b>		\$1,544,154	\$1,538,035	-0.4%

*We also note that Segal's Normal Cost for the active test life suite matched Findley within 2% and the Actuarial Accrued Liability matched Findley within 0.1%.*

#### Terminated Vested Test Lives

Plan	Description	Findley	Segal	Percent Difference
<b>Legacy</b>	• State employee, no account balance	\$32,276	\$32,584	1.0%
<b>Hybrid</b>	• Teacher, account balance exceeds annuity value	12,281	12,251	-0.2%
<b>Total Terminated Vested Test Life Suite:</b>		\$44,557	\$44,835	0.6%

#### Pay Status Test Lives

Plan	Description	Findley	Segal	Percent Difference
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<b>Legacy</b>	• State, disabled retiree, Member Only Option	\$254,799	\$254,800	0.0%
	• State, nondisabled retiree, SS Leveling Option	113,539	113,576	0.0%
	• State, surviving beneficiary	61,928	61,928	0.0%
	• Teacher, nondisabled retiree, J&S Option 1	259,641	259,641	0.0%
<b>Hybrid</b>	• Teacher, nondisabled retiree, Member Only Option	37,813	37,813	0.0%
<b>Total Pay Status Test Life Suite:</b>		\$727,720	\$727,758	0.0%

## Section IV: Parallel Valuation Results

### Liability Replication

In replicating the results of the TCRS valuations as of July 1, 2019, we found that, overall, Findley has a sound valuation process. We matched the valuation results and the test life output within an acceptable range. A comparison of the valuation results is displayed on the following page. Differences less than 5% are generally considered a reasonable match. The results are well within that tolerance.

Please note that Segal's results throughout this section do not include the effect of the programming recommendations presented later in this section. The results shown represent the closest match of Findley results based on our reading of their valuation report, the test life information provided, and their responses to our follow-up questions.

As described earlier, our parallel valuation was limited to the State and Higher Education Employees and K-12 Public School Teacher classifications of both the Legacy and Hybrid Plans. Therefore, the Findley results presented here do match exactly to any numbers shown in the TCRS valuation reports as of July 1, 2019. The results for the specific subgroupings were provided to Segal by Findley.

#### Legacy DB Plan

	Findley	Segal	Percent Difference
<b>Active Members</b>			
• Actuarial Present Value of Projected Benefits	\$18,352,919,400	\$18,795,513,406	2.4%
• Total Normal Cost	481,899,930	491,983,442	2.1%
• Normal Cost (Net of Employee Contributions)	323,293,396	333,122,425	3.0%
• Actuarial Accrued Liability (AAL)	13,950,614,787	14,308,481,130	2.6%
<b>Inactive and Vested Deferred Members</b>	\$1,675,097,636	\$1,683,800,928	0.5%
<b>Retirees and Beneficiaries</b>	\$23,082,525,539	\$22,914,715,285	-0.7%
<b>Total</b>			
• Actuarial Present Value of Projected Benefits	\$43,110,542,575	\$43,394,029,619	0.7%
• Actuarial Accrued Liability (AAL)	38,708,237,962	38,906,997,343	0.5%

#### Hybrid DB/DC Plan

	Findley	Segal	Percent Difference
<b>Active Members</b>			
• Actuarial Present Value of Projected Benefits	\$1,924,383,699	\$1,946,622,653	1.2%
• Total Normal Cost	129,018,984	126,227,938	-2.2%
• Normal Cost (Net of Employee Contributions)	33,473,599	30,067,958	-10.2%
• Actuarial Accrued Liability (AAL)	375,915,569	428,793,452	14.1%

<b>Inactive and Vested Deferred Members</b>	\$45,040,554	\$45,349,096	0.7%
<b>Retirees and Beneficiaries</b>	\$656,271	\$656,250	-0.0%
<b>Total</b>			
• Actuarial Present Value of Projected Benefits	\$1,970,080,524	\$1,992,627,999	1.1%
• Actuarial Accrued Liability (AAL)	421,612,394	474,798,798	12.6%

Actuarial firms each have their own software programs for calculating normal costs and liabilities. Even with the same actuarial assumptions and cost method, it is unlikely that any two firms will perform calculations in exactly the same way. For example, even though Findley and Segal both assumed mid-year decrements, the application of that methodology was different between the two firms. Ultimately, we were able to approximate Findley's mid-year methodology. Pointing out software differences should not be construed as an indication that one firm or the other is "correct." We do so only to provide complete disclosure.

In particular, differences between firms in the determination of the Normal Cost and Actuarial Accrued Liability are very common. As can be seen in the chart above, the replication of the Total Actuarial Present Value of Projected Benefits was within 0.7% (Legacy) and 1.1% (Hybrid). However, our methodology yields a 10.2% lower Normal Cost in the Hybrid Plan, causing Segal's Actuarial Accrued Liability to be 12.6% higher. There are two Hybrid Plan characteristics that led to minor differences in Segal and Findley methodology to result in more significant differences in results:

- The final Normal Cost shown in each year's valuation is the *Employer* Normal Cost, calculated as the "Total" Normal Cost expected to be sufficient to fund the plan of benefits, minus the expected employee contributions for the year. The Total Normal Cost is the key metric produced by the valuation program, and where the differences in results occur. In the case of the Hybrid Plan, the expected employee contributions cover a very significant portion of the Total Normal Cost (approximately 75%) under both Segal and Findley calculations, meaning that any difference in Total Normal Cost between firms will magnified in the final *Employer* Normal Cost. Our results show a close match in Total Normal Cost for the Hybrid Plan (2.2%), which is then magnified in final *Employer* Normal Cost (10.2%). **We are comfortable with the difference in Hybrid Plan Normal Cost and do not believe it indicates that Findley's results were incorrect, nor that there were any material differences between Findley and Segal calculations.**
- Since the Hybrid Plan was implemented for employees hired on or after July 1, 2014, the majority of the expected future benefits have not yet been "accrued" by participants. In other words, the Actuarial Accrued Liability is small percentage of the Actuarial Present Value of Benefits (approximately 20%). Again, this means that small differences in methodology in the allocation of benefits between Actuarial Accrued Liability and Normal Cost is magnified in the final Actuarial Accrued Liability. Our results show the Hybrid Plan Actuarial Accrued Liability is 12.6% higher than Findley's results, despite the close match in the Actuarial Present Value of Benefits of 1.2%. **We are comfortable with the difference in Hybrid Plan Actuarial Accrued Liability and do not believe it indicates that Findley's results were incorrect, nor that there were any material differences between Findley and Segal calculations.**

The results for State Employees and Teacher classification for each plan are shown below:

### Legacy DB Plan

#### State Employees/Higher Education Employees

	Findley	Segal	Percent Difference
<b>Active Members</b>			
• Actuarial Present Value of Projected Benefits	6,203,858,941	6,505,983,442	4.9%
• Total Normal Cost	157,340,385	163,296,126	3.8%
• Normal Cost (Net of Employee Contributions)	157,340,385	163,296,126	3.8%
• Actuarial Accrued Liability (AAL)	4,919,101,422	5,145,798,600	4.6%
<b>Inactive and Vested Deferred Members</b>	1,021,743,228	1,040,238,982	1.8%
<b>Retirees and Beneficiaries</b>	9,232,953,381	9,163,211,750	-0.8%
<b>Total</b>			
• Actuarial Present Value of Projected Benefits	16,458,555,550	16,709,434,174	1.5%
• Actuarial Accrued Liability (AAL)	15,173,798,031	15,349,249,332	1.2%

### Hybrid DB/DC Plan

#### State Employees/Higher Education Employees

	Findley	Segal	Percent Difference
<b>Active Members</b>			
• Actuarial Present Value of Projected Benefits	781,437,812	785,316,022	0.5%
• Total Normal Cost	57,146,172	55,821,806	-2.3%
• Normal Cost (Net of Employee Contributions)	13,784,937	11,978,773	-13.1%
• Actuarial Accrued Liability (AAL)	155,056,472	174,946,459	12.8%
<b>Inactive and Vested Deferred Members</b>	21,474,273	21,694,499	1.0%
<b>Retirees and Beneficiaries</b>	363,827	363,806	-0.0%
<b>Total</b>			
• Actuarial Present Value of Projected Benefits	803,275,912	807,374,327	0.5%
• Actuarial Accrued Liability (AAL)	176,894,572	197,004,764	11.4%

## Legacy DB Plan

### K-12 Public School Teachers

	Findley	Segal	Percent Difference
<b>Active Members</b>			
• Actuarial Present Value of Projected Benefits	12,149,060,459	12,289,529,964	1.2%
• Total Normal Cost	324,559,545	328,687,316	1.3%
• Normal Cost (Net of Employee Contributions)	165,953,011	169,826,299	2.3%
• Actuarial Accrued Liability (AAL)	9,031,513,365	9,162,682,530	1.5%
<b>Inactive and Vested Deferred Members</b>	653,354,408	643,561,946	-1.5%
<b>Retirees and Beneficiaries</b>	13,849,572,158	13,751,503,535	-0.7%
<b>Total</b>			
• Actuarial Present Value of Projected Benefits	26,651,987,025	26,684,595,445	0.1%
• Actuarial Accrued Liability (AAL)	23,534,439,931	23,557,748,011	0.1%

## Hybrid DB/DC Plan

### K-12 Public School Teachers

	Findley	Segal	Percent Difference
<b>Active Members</b>			
• Actuarial Present Value of Projected Benefits	1,142,945,887	1,161,306,631	1.6%
• Total Normal Cost	71,872,812	70,406,132	-2.0%
• Normal Cost (Net of Employee Contributions)	19,688,662	18,089,185	-8.1%
• Actuarial Accrued Liability (AAL)	220,859,097	253,846,993	14.9%
<b>Inactive and Vested Deferred Members</b>	23,566,281	23,654,597	0.4%
<b>Retirees and Beneficiaries</b>	292,444	292,444	0.0%
<b>Total</b>			
• Actuarial Present Value of Projected Benefits	1,166,804,612	1,185,253,672	1.6%
• Actuarial Accrued Liability (AAL)	244,717,822	277,794,034	13.5%

## Contribution Rates

We were able to replicate the methodology used to determine the amortization payments on the unfunded actuarial accrued liability, and consequently, the total and employer contribution rates, as a percentage of payroll.

## Recommendations

As mentioned previously, the results presented throughout this section represent the closest match of Findley results based on our reading of their valuation report, the test life information provided, and their responses to our follow-up questions. Given that we were able to replicate their results closely, we are confident that we understand Findley's programming methodology. With that in mind, we offer the following suggestions to improve the accuracy of the results:

1. Return of Excess Contributions – TCA 8-37-212 provides that the excess, if any, of accumulated contributions over the sum of actual retirement allowance payments received be paid as a lump sum to the surviving beneficiary or estate. Our analysis of the test lives indicates that this provision was not valued in the liability, although it is described on page G-2 of the Legacy valuation report. **We recommend that Findley program the return of contributions plan provision.**

We estimate that implementing this change would increase the Actuarial Accrued Liability by approximately \$157 million, or 0.40%, across all groups studied.

2. For current terminated vested participants and for Legacy vested active participants assumed to withdraw from employment before eligibility for retirement and elect a deferred annuity, Findley programming assumes there is no liability for deaths prior to commencement of the deferred annuity. However, a death benefit would be payable in that situation (an annuity to married participants with 10 or more years of service or lump sum return of contributions in all other cases). **We recommend that Findley program these pre-retirement death benefit provisions.**

We estimate that implementing this change would increase the Actuarial Accrued Liability by approximately \$7 million, or 0.02%, across all groups studied.

3. For retirements from active status, Findley currently assumes that no participants will elect reduced early retirement benefits. We think this is likely an oversimplification (although we have not analyzed any actual retirement experience). **We recommend use of early retirement decrements and anticipate that implementing a reduced early retirement assumption would increase liabilities for the Legacy Plan.** However, the magnitude of the change would be dependent on the exact assumptions chosen. We expect this change would have less of an impact on the Hybrid Plan due to fact that early retirement reductions are calculated based on actuarially equivalent factors in that plan.
4. For future vested terminations from active status in the Legacy Plan, Findley assumes that terminated vested participants will retire at the first retirement eligibility. This differs from the stated assumption and the assumption used for current Legacy terminated vested participants (as well as the assumption used for the Hybrid Plan), which is that the participant will retire at the first service retirement eligibility. **Unless there is reason to believe that current and future terminated vested participants will behave differently, we recommend applying the same assumption in both scenarios.**
5. Furthermore, a single retirement age for terminated vested participants is unlikely to adequately capture the range of retirement scenarios for such participants. **Our preference is to set a table of rates based on age/eligibility, similar to the assumption for retirements from active status.** We expect that implementing this change would decrease

the liability for those currently assumed to retire at early retirement eligibility. For those currently assumed to retire at service retirement eligibility, the result would likely be an increase in liability (but could still be a decrease if the assumed rates extend beyond the service retirement date). The magnitude of any change would be dependent on the exact rates chosen.

6. For future vested terminations from active status in the Legacy Plan, Findley does not compare the present value of the deferred annuity with an immediate return of contributions. This differs from the methodology used for current terminated vested participants, where the greater present value is taken. **We recommend implementing the same comparison of return of contributions or deferred annuities for future terminations.**

We estimate that implementing this change would increase the Actuarial Present Value of Benefits by approximately \$14 million, or 0.03%, across all groups studied.

7. For future retirements from active status, the programming of the first-year cost of living adjustment (COLA) appears to be inconsistent between the Legacy and Hybrid Plans. For the Legacy Plan, there is no COLA given as of the July 1<sup>st</sup> following the year of retirement. We believe this is correct because retirements are assumed to occur in the middle of the year and no COLAs are given until the July 1<sup>st</sup> following completion of 12 full months of retirement. However, for the Hybrid Plan, there appears to be approximately a half year of COLA given as of the July 1<sup>st</sup> following the year of retirement. **We recommend adjusting the Hybrid Plan coding to match the Legacy Plan coding.**

We estimate that implementing this change would decrease the Actuarial Accrued Liability by approximately \$4.4 million, or 0.92%, for the Hybrid Plan.

8. Findley notes in its summary of plan provisions that all pre-retirement deaths are assumed to be ordinary (i.e. not in the line of duty). We expect that, in most cases, the benefit for a line-of-duty death would be more valuable than the ordinary death benefit so that implementing any probability of line-of-duty deaths would increase liabilities. However, the magnitude of the change would be dependent on the exact assumption chosen.
9. For pre-retirement deaths that occur after reaching retirement eligibility, an annuity is payable to the beneficiary of all participants (not just married participants). Findley's current methodology assumes that only 80% of participants (those assumed to be married) receive the annuity, while the remaining 20% receive the lump sum death benefit. **We recommend valuing the greater of the two possible death benefits for 100% of deaths occurring after retirement eligibility.**

We estimate that implementing this change would increase the Actuarial Accrued Liability by approximately \$28 million, or 0.07%, across all groups studied.

10. For pre-retirement deaths that occur before reaching retirement eligibility and where the participant is assumed to be married, Findley's coding for the Hybrid Plan does not appear to reflect any early retirement reductions that would apply. **We recommend applying the early retirement reductions, where applicable.**

We estimate that implementing this change would decrease the Actuarial Accrued Liability by approximately \$4.6 million, or 0.97%, for the Hybrid Plan.

11. We note that Findley does not assume that future disabled retirees will receive any worker's compensation benefits when determining the maximum disability benefit payable from the Plan. In the absence of any information to the contrary, we agree that this seems to be a reasonable assumption.
12. We note that, for Legacy participants hired before July 1, 1997, Findley does not assume that any future disablements will occur in the line-of-duty. Given that the ordinary and line-of-duty disability benefits are identical for those hired on or after July 1, 1997, we agree that this is a reasonable simplification due to its immateriality.

## Section V: Conclusions

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To reiterate our comments in the Executive Summary, Findley appears to have reasonably valued the expected liability, based on their stated assumptions and methods, of both the Legacy Plan and the Hybrid Plan for the State Employees and the K-12 Teachers classifications. Findley has applied the funding methodology appropriately to develop contribution recommendations for the Legacy Plan and Hybrid Plan, and the valuation reports conform to accepted actuarial principles and practices.

In this audit, we have noted areas that we believe will refine the liability calculations and improve the usefulness and clarity of the System's annual actuarial valuation reports. We are available to discuss any aspect of our review with the State of Tennessee Treasury Department, the TCRS Board of Trustees, TCRS Staff, or the System's actuary.

Segal is independent of Findley, and we are not aware of any conflict of interest that would impair the objectivity of our actuarial audit of their work.